

the English Channel; and he discusses the value of this discovery from the point of view of the Swedish, Danish, and German eel-fisheries. We await with considerable interest the further account of these remarkable investigations.

The other reports are also of considerable interest. Mr. A. C. Johansen writes on the life-history of the young post-larval eel. Mr. A. S. Jensen contributes a paper on the occurrence of the otoliths of Gadoid fishes in the bottom deposits of the polar seas between the Færøes, Jan Mayen, and Scotland. Samples of mud obtained from the sea-bottom in these regions frequently contained otoliths derived from various *Gadus* species. Nevertheless, the trawling operations of the *Michael Sars* showed that the cod does not live at the bottom of these seas. The occurrence of *Gadus* otoliths is therefore to be explained by the horizontal migration of these fishes from the shore grounds near the surface of the sea. Some observations made by Mr. T. Scott on the occurrence of whiting otoliths in the stomach of the porpoise show also that these structures may be distributed over wide areas of sea-bottom, since whiting are eaten in large numbers by the porpoise and the otoliths may be evacuated in an undecomposed condition. This is presumably the case also with other of the smaller gadoid fishes.

The remaining papers include a study of the post-larval stages of *Gadus*, spp., and of *Brosimius brosme* by Mr. J. Schmidt, both notable additions to the literature of the subject, and a description of several new Peridiniens by Mr. O. Paulsen.

JAS. JOHNSTONE.

THE EVOLUTION OF BIOLOGY.

Geschichte der biologischen Theorien, seit dem Ende des siebzehnten Jahrhunderts. Teil i. By Dr. Em. Radl. Pp. vii+320. (Leipzig: W. Engelmann, 1905.) Price 7s. net.

ALTHOUGH biology is now permeated by the evolution idea, and has continually before it the ideal of giving a genetic description of the present phase of the animate world, there is some reason to fear, as Dr. Radl indicates, a growing apathy towards the study of the evolution of the science itself. Whether it be that many workers share Nietzsche's view that the study of history paralyses the intelligence, or that they feel it their primary business to make history, not to read it, or that they regard historical inquiries as the philosopher's task, not theirs, it seems certain that too little attention—in our investigations, theories, and teaching alike—is paid to the historical evolution of the science. A notorious example may be found in the biological work of Herbert Spencer, who, though he had almost accidentally found inspiration from a slight acquaintance with the work of von Baer, deliberately set his face against looking for more. He preferred to think for himself. But all cannot be excused as we excuse Spencer, and even his work suffered from his peculiarly detached independence of outlook. Whether we will or no, the past lives in the present, and he who thinks himself most emancipated from all scien-

tific tradition may be a signal instance of the rehabilitation or recrudescence of doctrines which characterised his unknown intellectual ancestors. It is not as if scientific discoveries were successive special creations which had their day and ceased to be, giving place to others unaffiliated to them. On the contrary, as Dr. Radl's book, and any other piece of careful historical work, shows, biology is an evolution. Generalisations grow and vary, there is an amphi-mixis of ideas, there is an adaptation to the social environment, there is a struggle for existence and a survival of the fittest.

Without much discussion of the factors which brought about the scientific renaissance, Dr. Radl begins by showing how the influence of Aristotle persisted in men like Cæsalpinus, Harvey, Glisson, and Redi. The second chapter shows how the mechanical modes of interpretation, vindicated by the physicists, began to insinuate themselves into biology, through Descartes, Borelli, Fr. Hoffmann, and Dr. Willis. The advent of the microscope is then discussed, and an interesting account is given of the work and influence of Malpighi and Swammerdam. A reaction from Cartesian mechanism found expression through the genius of Leibnitz, and vitalism its first thorough-going exponent in Stahl.

The fifth chapter deals with the first half of the eighteenth century, with the successors of Malpighi and Swammerdam, and with the early preformationists, such as Bonnet, Haller and Buffon. Then follows an account of Linné's systematic work. Wolff is the central figure of the next chapter, which deals with the foundation of the epigenetic theory. Gradually the conception of individual development expanded into that of racial evolution, but even more in the minds of philosophic thinkers than of naturalists. The ninth chapter gives us the history of the rise and progress of morphology, illustrated especially with reference to Cuvier and Étienne Geoffroy St. Hilaire, Jussieu and P. De Candolle. After a brief chapter on Bichat as representative of vitalism at the end of the eighteenth century, the author passes to a more detailed study of the German "Naturphilosophie," as illustrated by Herder, Kant, Fichte, and Schelling among philosophers, by Kiemeyer, Goethe, Oken, Blumenbach, and Treviranus among biologists. The present volume merely begins the story of the evolution of evolution theory, the two last chapters being devoted to Erasmus Darwin and Lamarck.

Having indicated the scope of this valuable historical treatise, we must now express our high appreciation of the author's workmanship. He shows a first-hand acquaintance with the works with which he deals, and yet he has not allowed himself to be overwhelmed by his scholarship. He has a keen selective instinct and a rare terseness, and although he has written in what was to him a foreign language, his style is lucid and often vivid. One cannot but be impressed in reading the interesting history with Dr. Radl's calmness and independence of judgment; he is neither depreciative of men like Oken nor eulogistic of men like Lamarck; he states their case with justice, and gives chapter and verse for his judgments. In some cases,

e.g. that of Lamarck, his estimate is by no means that which many authoritative writers have expressed.

As we lay aside the volume some general reflections remain convincingly with us—that the history of biology is a rational evolution, and at the same time inextricably intertwined with social evolution; that the same general ideas are re-incarnated century after century in more evolved forms; that each generation meets the same old difficulties on a higher turn of the spiral; that clearly thought-out conceptions which seem for a time to be vanquished re-assert themselves with renewed vigour, and find their position in a more complete synthesis. The modern biologist, intent on new discoveries, has no use for Aristotle, Descartes, and Leibnitz, but their influence may be upon him none the less. In speaking of the aqueduct of Sylvius, the Malpighian tubules, the Graafian follicle, or the Cuvierian organs, we quaintly acknowledge our debt to the past, but perhaps we betray our indebtedness more when we are least conscious of it, for even the most modern system of biology is, like our own body, a veritable museum of relics.

J. A. T.

STOMATA AND PHYLOGENY.

Der Spaltöffnungsapparat im Lichte der Phylogenie. Ein Beitrag zur "phylogenetischen Pflanzenhistologie." By Dr. Otto Porsch. Pp. xiv+196. (Jena: Gustav Fischer, 1905.) Price 8 marks.

THIS work, as its title announces, is an attempt to use the stoma as a mark of relationship, and thus to make it serve as a guide to the phylogeny of plants. The author is filled with a pleasant enthusiasm for his subject, and this he contrives to convey to his readers, who, whether or no they are in complete agreement with his views, will not deny that he has produced an interesting and suggestive book. Personally, we think he has done more, and that his work has decided value. He begins by showing (what has to some extent been shown before) that definite types of stoma run through certain classes or natural orders. He makes it clear that these types remain recognisable even in plants exposed to various environments. The gymnospermous type, for instance, occurs in plants of such diverse habit as *Bowenia*, *Ginkgo*, *Dioon*, and *Gnetum*.

The author allows that the gymnosperm type is essentially a stoma adapted to xerophytic conditions. This brings us face to face with what is a difficulty in inquiries of this sort—namely, how far persistence of type is due to adaptation. This is especially difficult in regard to the xerophytic habit, because our knowledge of the conditions which make this habit of value is recent, and probably incomplete. It is only comparatively lately that conditions of life in a salt-marsh, an English heath, and in the alpine regions of the tropics have been recognised as equivalent environments in regard to transpiration. The author is, however, fully aware of the difficulty in question.

It is interesting to find the gymnospermous stoma occurring in *Casuarina*, a genus known to possess morphological characters which have suggested that it may be an offshoot from an ancestor common to

gymnosperms and angiosperms. In concluding this section the author has some remarks on the minuter taxonomic value of the stoma, *e.g.* in *Dasyllirion*, where the stomatal characteristics may be used to distinguish the species. He also directs attention to the *Commelinaceæ* and *Eriocaulaceæ*, and to the genus *Eucalyptus*, in all of which the stoma is characteristic. As showing the possible value of the stoma to the palæobotanist he quotes the case of a fossil *Potamogeton* recently shown by its stomatal type to belong to the *Loranthaceæ*. Porsch gives an interesting account of reduced and rudimentary stomata in the true leaves of *Ruscus*, in parasites, and in submerged plants. The latter case is especially interesting because here the stomata can hardly be of use for gaseous exchange. But in the petals of flowers or the bulky stems of holoparasites it is clear that they may be of importance for respiration. This is a function of the stoma which Porsch does not sufficiently discuss; thus in referring to the stomata of petals he considers transpiration alone. The fact that large petals occur devoid of stomata while others (*Galtonia*) have perfect ones shows that the question is in need of physiological inquiry.

In another interesting section the author describes the stomata of seedling leaves, which are generally of an undifferentiated type, even when the adult leaves have highly specialised stomata, *e.g.* in *Hakea*, *Spartium junceum*, &c. This seems at first sight a case of "recapitulation," but the author is careful to supply an alternative view, viz. that in the early stages of existence a plant is less subject to drought, so that the simple stomata of the seedling may be an adaptation to conditions less rigorous than those to which the adult is exposed. The author, however, accepts, with certain reservations, the recapitulation point of view.

The last section of the book deals with stomata in relation to alternate generation. Porsch holds (with Wettstein) the sporophyte to be an adaptation to life on dry land in contrast to the gametophyte, which retains aquatic characters. Taking the Bryophytes as the lowest class in which stomata occur, he again follows Wettstein in placing the mosses in the lower division, the liverworts being a more specialised form. It is in harmony with this view that in the mosses stomata should occur only in the sporophyte. Among the normal two-celled stomata are occasionally found others of the four-celled type. This he looks on as a "reminiscence" of an earlier form, in which the intercellular spaces open externally in the simplest manner between four epidermic cells.

In the liverworts, on the other hand, the gametophyte possesses openings which function as stomata. There is only one group in the liverworts which exhibits a highly organised sporophyte, and here in *Anthoceros* we find true stomata having a pair of guard cells, which are probably of a higher type than occurs elsewhere among the Bryophytes.

Among the Pteridophytes the most interesting fact is that the stomata are of a type that may be supposed to be the forerunner of the gymnospermous stoma. The characteristic lignification is not always present